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ABSTRACT

Subjects in the first part of this two-part study (56 undergraduates) read a 24-frame text on computer programming that was presented either in logical or in random order. The results of this experiment showed that the subjects given an advance organizer in the random order presentation performed better on a posttest than did control subjects (no advance organizer); in the logical order presentation, however, the subjects given an advance organizer performed no better on the posttest than did control subjects. In the second part of the study, 96 undergraduates read a four paragraph text about imaginary countries that was presented in name or attribute organization. Low ability subjects given an organizer prior to reading performed better on questions that required integrating across different paragraphs of the presented text, while subjects given the organizer after reading performed relatively better on questions concerning information they had read within the same paragraph. Apparently, advance organizers provide an assimilative context for organizing any incoming information that is awkward or unfamiliar in its presentation order, but they have no positive effect when information is presented in a logical manner and the test questions reflect the organization of the presentation. (RL)

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Can Advance Organizers Counter the Effects of Text Organization?

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Advance Organizers that Compensate for the Organization of Text

The present paper investigates the role of advance organizers on learning from unfamiliar text. According to assimilation theory (Mayer, 1975a) advance organizers may be especially important for the learning of technical, unfamiliar or poorly organized material because they serve the following functions. (1) Availability. A meaningful context is provided to which new material may be assimilated. Ausubel (1968, p. 148) has argued that meaningful learning requires having relevant "ideas already available in cognitive structure," and that for advance organizers to provide these "anchoring ideas or subsumers" the advance organizer must be "presented at a higher level of abstraction, generality or inclusiveness." The question of what makes an advance organizer "meaningful" is one that can better be settled with the benefit of more experimental testing rather than relying on Ausubel's definition alone. (2) Activation. Advance organizers may also serve to encourage an encoding strategy in which the learner attempts to integrate incoming information with the meaningful context. Unfortunately, there has been very little research on this issue, namely if and how organizers affect encoding (as compared to retrieval, for example).

Mayer (1975a) has suggested three theories of the learning process: the assimilation model which suggests that a meaningful context can serve to generate a broader learning outcome, the addition model which suggests that a meaningful context can serve to generate more learning

overall, and the reception model which suggests that a meaningful context does not influence the learning of other related information. Most of the research on advance organizers has tested, implicitedly or explicitly, the addition model against the reception model. The results have generally produced small but inconsistant differences in which the advance organizer group recalled more of the facts than the control group (Ausubel, 1977, 1968; Mayer, 1977a; Lawton & Wanska, 1977; Barnes & Clawson, 1975). The present studies attempted to extend this work by investigating the implications of all three models.

These theories produce testable predictions concerning posttest performance. The assimilation theory predicts that the broader learning outcome of the advance organizer subjects should result in better transfer but poorer retention performance as compared to subjects who did not have the organizer prior to learning. The addition theory predicts only that the advance organizer group might perform better overall on all questions due to having more "anchors" for hooking up incoming ideas. Finally, the reception theory predicts that if the test is based solely on the information presented in the text, then the advance organizer should have no effect for near or far transfer tests. A recent series of experiments (Mayer, 1975b, 1976a, 1976b, 1977b) clearly supports the predictions of the assimilation theory when material was technical and unfamiliar to subjects.

The present paper investigates a second major prediction concerning the effect of advance organizers on logically and poorly organized text.

The assimilation theory predicts that posttest performance should be improved by advance organizers when the material is randomly (or poorly) organized but not when it is logical; when the material is logically organized subjects may be able to integrate the material on their own but when the material is not presented in the optimal organization a meaningful learning set can serve as a context for integrating and holding together the incoming material. According to the addition theory, posttest performance should increase for both logical and random texts if advance organizers are given. According to the reception theory, advance organizer should not influence performance for either type of presentation if the test does not directly involve the advance organizer material.

Since the literature on text organization has been reviewed elsewhere (Mayer, 1977a), it can be summarized here by stating that the results are contradictory. One important study that sheds some light on the conflict was Tobias's (1973, 1976) study, replicated by Dyer & Kulhavy (1974), in which significant scrambling effects were obtained for a technical version of the text but not for a familiar version. These results encourage the idea that poor organization can be compensated for by making sure the reader has a meaningful context for integrating the incoming material, as would be expected for a familiar text. Another way to provide such a context when the material is technical is to use a familiar advance organizer as will be investigated in the present studies.

Experiment 1

Method

Subjects and design. The subjects were 56 college students recruited from the Psychology Subject Pool at the University of California, Santa Barbara. The design was a 2 x 2 x 2 factorial with the factors being Organization of Text (Logical vs. Random), Advance Organizer (Before vs. None), and Mathematical Ability (High vs. Low). Seven subjects served in each cell, with all subjects contributing measures for six within subject tests.

Materials. The materials included a 24-frame sequence for basic computer programming, with each frame consisting of 100 to 200 words typed onto a 4 x 6 inch index card (modified from Mayer, 1976a). Two sets of 24 frames were constructed: the headings set contained 2 to 8 word underlined headings at the top on each frame, and the no heading set did not. In addition, a 500-word advance organizer which described a computer in familiar terms was typed onto a sheet of paper (modified from Mayer, 1975), and a heading list containing a listing of the titles of the 24 frames was typed onto another sheet of paper.

An 18-item test was constructed with individual questions typed on 3 x 5 inch index cards. The questions were modified from Mayer (1975b, 1976a) and consisted of three items for each cell of a 2 x 3 factorial test design. The factors were type of question (e.g., whether the question asked the subject to generate a program, or to interpret what a given program would do) and length of question (e.g., whether the question

dealt with a one-line program, a 4 to 8 line program that did not involve looping, or a 4 to 8 line program requiring looping). Additional materials included an answer sheet for the test and a subject pretest which asked the subject to give his/her SAT-Mathematics score and to solve six algebra substitution problems.

Procedure. Subjects participated in the one to two hour experiment in groups of two to four, with subjects randomly assigned to treatments. First, subjects completed the pretest; subjects scoring above 550 on the SAT-M were classified as high ability and those scoring below were classified as low ability.

Instructions for the reading task were read to the subjects. Prior to reading the 24 frames, the Before Group was given the advance organizer sheet and heading list to read at their own rates. The None Group received neither. The materials were then collected, and the 24-frame instructional decks were given to each subject. Subjects in the Logical Group received the cards in their natural sequence while subjects in the Random Group received them in individual orders determined by random number tables (see Mayer, 1976a, p. 148). Subjects read at their own rates but they could read only one card at a time and they could not go back to read previous cards.

Following reading the 24-frame deck, subjects were given instructions for the test and an 18-card test deck. The order of test items was random except that the three questions of each kind occurred together. Subjects solved at their own rates but could work on only one card at a time and could not go back to work on previous cards.

Results and Discussion

Three subjects failed to complete the experiment and three subjects expressed familiarity with computer programming, so new subjects were recruited in their places. Unlike previous experiments (Mayer, 1975b, 1976s) subjects who reported low SAT-M scores and who failed to pass the pretest were retained (in the Low Ability group). Answers to the test were scored as correct or incorrect and were analyzed by a five factor analysis of variance (Text Organization x Advance Organizer x Ability x Type of Question x Length of Question).

As expected the High Ability subjects scored significantly higher than the Low Ability subjects with scores of 48% vs. 28% correct respectively, $F(1,48) = 18.29$, $p < .001$. There were no differences in overall performance between subjects who were given the advance organizer and subjects not given the organizer (38% correct for each group, $F(1,48) < 1$). In addition, Logical Organization produced overall scores that were indistinguishable from the Random Organization (40% vs. 36% correct respectively, $F(1,48) < 1$).

The main focus of the present study was to determine whether advance organizers serve to counteract the effects of poor text organization. For example, if advance organizers serve as assimilative contexts then one would predict that there should be no positive effect of advance organizers for Logical Organization but that advance organizers should aid for Random Organization. This prediction was upheld in a significant interaction between Text Organization and Advance Organizer, $F(1,48)=4.12$, $p < .05$. TAble 1 summaries this pattern in which the Before Group performed bette

than the None Group on Random Organization but worse when the text was presented in Logical Organization.

In addition, the only other significant effect was an interaction between Advance Organizer and Type of Question in which the Before group performed better than the None group (38% correct vs. 29% correct) on far transfer questions involving interpretation while the None group outperformed the Before group on near transfer questions involving generation (46% vs. 39% correct). This interaction, $F(1,48) = 4.81$, $p < .05$, replicates the results of previous studies (Mayer, 1975b, 1976a). As in those studies,a reasonable conclusion is that the advance organizer allowed subjects to assimilate new material and form a broader learning outcome.

Insert Table 1 about here

Experiment 2

Method

Subjects and design. The subjects were 96 college students recruited from the Psychology Subject Pool at the University of California, Santa Barbara. None of the subjects reported having prior experience with the previous experiment. Twelve subjects served in each cell of a 2 x 2 x 2 factorial design. The factors were: Organization of Text (Name vs. Attribute), Sequencing of Advance Organizer (Before or After), and Ability of Subjects (High vs. Low). All subjects received the same four tests so comparisons involving test type are within subject comparisons.

Materials. Materials consisted of two versions of the text, an advance organizer, four tests, and a subject questionnaire.

The text consisted of 16 sentences concerning four attributes (economy, politics, climate, geography) of four imaginary countries (Brontus, Atweena, Galbion, Nurmania), with four sentences typed on four 3 x 5 inch index cards. For the Name Organization Text, each card contained the four sentences describing the attributes of a single country, and the card was headed with the name of the country. For the Attribute Organization text, each card contained four sentences describing the same attribute for all four countries, and the card was headed with the name of the attribute.

An example of the information on a name organization card is: "Facts about Galbion. Galbion is land-locked and has no outlet to the sea. The temperatures in Galbion are generally mild. Currently, a military dictatorship is in charge of Galbion. In Galbion, the people work mainly in tourist resorts."

An example of the information on an attribute organization card is: "Facts about Geographies. Galbion is land-locked and has no outlet to the sea. An isolated island is the location of Nurmania. There are many splendid lakes in Brontus. There are many beautiful mountains all across Atweena."

The advance organizer consisted of an 8-1/2 x 11 inch sheet of paper that was divided into a 4 x 4 matrix of squares; the squares were empty but the rows were labeled with the attribute names (economy, politics, geography, climate) and the columns were labeled with the country names (Brontus, Atweena, Galbion, Nurmania).

The four tests were typed onto 8-1/2 x 5-1/2 inch sheets of paper. The recall-name test asked: "In the space below write down all you can remember about Galbion." The recall-attribute test asked: "In the space below write down all you can remember about the geography of each country." The inference-name test consisted of 12 fill in questions that involved thinking about several attributes of just one country; for example: "What is the geography of the country with mild temperatures? _____." The inference-attribute test consisted of 12 fill in questions that involved thinking about one single attribute across several different countries; for example: "The lakes of Brontus are comparable to the _____ of Galbion."

The subject questionnaire solicited information concerning the subjects' age, sex, mathematics experience, SAT scores, and related information.

In addition, three stop watches were used to record individual reading and solution times. Three partitioned booths were also used; each had partitions on three sides to prevent eye contact among subjects, and the partition furthest from the subject had a 12 x 6 inch window through which cards could be passed to the experimenter.

Procedure. Subjects were run in small groups of 2 or 3 per session, and were randomly assigned to treatments. Subjects were seated in separate booths and could not see one another.

First, instructions for the reading task were read. Subjects were told to assume that they were diplomats and that they had to learn some

new information. Subjects were told to read the first card, then slide it out the window when they had learned the information on it; then the next card was given, and so on. Thus subjects saw only one card at a time and could not go back to previous cards. Each subject worked at his/her own rate and the experimenter recorded the total reading time for all four cards. The order of the four cards was randomized, except that subjects in the Name Organization Group received the four name cards and subjects in the Attribute Organization Group received the four attribute cards.

In addition, subjects in the Before Group were given the advance organizer just prior to reading, but after the instructions. They viewed the advance organizer for 60 seconds with the instructions, "Some subjects have found that this system makes your task easier; you may study it for 1 minute and then I will take it away." The After Group was given the same advance organizer and instructions after reading and just prior to the test.

When a subject finished reading, instructions for the test were given. Subjects were to work at their own rates and try to get as much correct as possible. The first test was given, and when the subject was finished the subject slid it out the window; then the next test was given and so on. Thus the subject worked on one test at a time and could not go back to work on previous tests. The order of the tests was always: recall-name, recall-attribute, inference-name, inference-attribute. The experimenter recorded the time spent on each test.

When the subject finished all four tests, the subject questionnaire was given. This was done to reduce the chances that subjects would be leaving the room while others were still working on the test.

Results and Discussion

An analysis of variance was performed on the total reading times using the three between subject factors of organization of text, position of advance organizer, and ability of subjects. For purposes of this and all other analyses, subjects with SAT-Mathematics scores of 550 or below were counted as low ability while subjects with scores above 550 were counted as high. The Attribute Organization Groups required much more reading time than the Name Organization groups, with average reading times of 488 vs. 283 seconds respectively, $F(1,88) = 43.01$, $p < .001$. Apparently, in the present situation, the name organization was more natural and consistent with the subjects' normal way of organizing information. This conclusion is similar to that of Schultz & DiVesta (1972) based on the finding that more is recalled for name organization than attribute organization of characteristics of countries and clustering in free recall tends to be by name for randomly presented information (see Mayer, 1977a, for a review). In addition, subjects who had seen the advance organizer prior to learning required less reading time (for example the advance organizer saved 60 seconds for the Attribute Organization subjects); however, differences involving this factor failed to reach statistical significance.

A second analysis of variance was performed on the test performance of subjects. The data consisted of the proportion correctly recalled on each of the two recall tests (out of four possible in each) and the proportion of correct answers on each of the two inference tests (out of 12 possible on each). In scoring, misspellings of country names and synonyms for attributes were allowed. The between subject factors were the same as above, and the within subject factors were Type of Test (Recall vs. Inference) and Organization of Test (Name vs. Attribute). Performance for the Attribute Organization Text was significantly better than for subjects who read the Name Organization Text, $F(1,88) = 6.84$, $p < .025$. Thus, although the Attribute Organization was much more time-consuming to read, the additional activity and effort required seems to have paid off in higher test scores. As expected, High Ability subjects performed better on the test than Low Ability subjects, $F(1,88) = 8.70$, $p < .01$ (see marginals of Table 2).

A major question addressed by this experiment was whether advance organizers might serve to counteract the effects of complex text organization. For example, if the advance organizer serves as an organizing or integrating context for the material in the text, one prediction is that it should not have a facilitative effect in situations where the subject already has a good means of remembering the information but that it should have a facilitative effect in situations where the presented information is organized differently from the test. In the present experiment, this pattern would be indicated by an interaction among Text Organization,

Advance Organizer, and Test Organization. Before and After subjects should perform at similar levels for questions that are in the same organization as in the text (Name Organization subjects on name questions, and Attribute Organization subjects on attribute questions); however, the Before group should perform better than the After on questions that are in different form than the text organization (Name Organization subjects on attribute questions, and Attribute Organization subjects on name questions). As shown in Table 2, this interaction reflects the performance of Low Ability subjects, but not High Ability subjects, and is consistent with the idea that High ability subjects have their own ways of integrating presented information (interaction among Text Organization, Advance Organizer, Ability, and Test Organization, $F(1,88) = 3.89$, $p < .06$).

Insert Table 2 about here

In order to more closely analyze this marginally reliable interaction, difference scores were constructed for each subject by subtracting the proportion correct on same questions (name questions for Name Organization Test subjects; attribute questions for Attribute Organization subjects) minus the proportion correct on different questions (attribute questions for Name Organization subjects; name questions for Attribute Organization subjects). For the Low Ability subjects, the Before Group received a difference score of -.14 compared to +.11 for the After Group, $t(46) = 2.07$, $p < .05$; the scores of Before vs. After groups for High Ability subjects (+.15 and +.08, respectively) were not significantly different from one

another ($t < 1$). These results support the earlier prediction that advance organizers should have their strongest positive effect on tasks that are different from the original organization and for subjects that might not otherwise use integrating contexts to encode the material.

Previous studies comparing name and attribute organization for passages indicates that subjects' ability to integrate information was influenced by presentation organization (see Mayer, 1977, for a review). For example, Frase (1973) found that subjects given attribute organization for passages about the characteristics of four ships performed better on questions involving one attribute (such as, "What color was the mast of the Squid that was red on the Shark?") and name organization subjects performed better on questions involving one name (such as, "What color was the mainmast of the ship that had a red jogger?"). The present results indicate that this pattern can be reduced by the use of advance organizers and thus suggest that subjects are able to encode the information in a more integrated form than simply copying the presentation organization.

General Discussion

In both studies, the results most closely supported the predictions of the assimilation theory; advance organizer subjects performed relatively better on questions that require integrating facts from across different sections of the text (i.e., Different Questions) while control subjects performed better on using facts that had occurred near one another in the text (i.e., Same Questions). In Experiment 1, the comparison between Same and Different was a between subject comparison since both groups received the identical questions but for the logical subjects they were

Sames and for the Random subjects they were Differents. In Experiment 2, the comparison was within subject since all subjects received questions based on the presentation organization (such as name questions for the Name Group, and attribute questions for the Attribute Group), and questions based on a different organization (such as attribute questions for the Name Group, and name questions for the Attribute Group).

Apparently, the advance organizers used in these studies served as integrating contexts to which new, incoming information may be assimilated. The organizers served to free the subject from the need to exactly encode items in an awkward or unfamiliar presentation order. When information is presented in a logical manner and the test questions reflect the presentation organization, an advance organizer has no positive effect; however, when the material is presented in an order that is inconsistent with the posttest question then advance organizers seem to have a facilitative effect. This effect provides an independent line of support for the assimilation theory which states that the organizer provides an assimilitive context for organizing the incoming information.

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Footnote

Requests for reprints should be sent to: Richard E. Mayer, Department of Psychology, University of California, Santa Barbara, California 93106. Kiki Litzie and Richard Hobbie assisted in the collection of data. This research was supported by Grant SED-77-19875 from the National Science Foundation.

Table 1

Proportion Correct Response for Before and None Groups Based on Logical and Random Texts

Advance Organizer	Organization	
	Logical	Random
Before	.36	.41
None	.44	.31

Table 2

Proportion Correct Response by Advance Organizer and Ability Groups for Same and Different Questions

Groups	Same Questions		Different Questions		Average
	Name Text & Name Question	Attribute Text & Attribute Question	Name Text & Attritute Question	Attribute Text & Name Question	Difference Score
Low Ability					
Before	.61	.74	.72	.78	-.14
After	.64	.81	.62	.71	+.11
High Ability					
Before	.81	.96	.77	.88	+.15
After	.76	.84	.75	.83	+.08